COMPAQ

PCL®-II Programmer's Reference Manual

5525B/31/32 Line Matrix Printer

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COMPAQ

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1 *Introduction*

About This Guide

Your printer comes equipped with the standard Hewlett-Packard® Printer Control Language (PCL®-II) emulation. This manual explains the emulation in detail.

The *Programmer's Reference Manual* is designed so that you can quickly find the information you need to use and configure your Compaq® 5525B/31/32 Series printer.

Warnings and Special Information

Read and comply with all information highlighted under special headings:

WARNING **Conditions that could harm you as well as damage the equipment.**

CAUTION **Conditions that could damage the printer or related equipment.**

IMPORTANT **Information vital to proper operation of the printer.**

NOTE: Information affecting printer operation.

Related Product Information

Refer to the following books for printer operation:

- *Compaq 5525B/31/32 Line Matrix Printer User's Manual*
  Provides information about installing and using your printer, basic operational procedures, configuration instructions, and troubleshooting guidelines. Describes the keys on the control panel and provides quick reference information on routine printer operations such as loading paper and replacing ribbons.
- *Compaq 5525B/31/32 Line Matrix Printer LinePrinter Plus Programmer's Reference Manual*
  Covers the host control codes and programming information for the LinePrinter Plus® emulations, including P-Series, IBM® Proprinter® XL and Epson® FX.
- *Compaq 5525B/31/32 Line Matrix Printer Maintenance Manual*
  This manual is not shipped with the printer, but can be ordered. It explains how to maintain and repair the 5525B/31/32 Series printer at the field service level of maintenance. This manual covers alignments and adjustments, preventive and corrective maintenance, troubleshooting, and basic principles of operation.

Software Features

The PCL-II emulation software provides the following features:

- Graphics and a selection of print densities. You can enable graphics mode and specify a density mode (dots per inch).
- Print Attributes. Characters can be bold, italic, double high, double wide, etc.
- Page Formatting. PCL-II commands allow you to set line spacing, page length, and vertical forms control.
- Font Typefaces. Also referred to as print modes. The five typefaces include Near Letter Quality (NLQ), Data Processing (DP), High Speed (HS), OCR A, and OCR B.
- Character Sets. Forty-seven character sets are available. You can print the character sets in the different print modes. (OCR A and B character sets must be printed in OCR A and OCR B print modes.)
- Bar codes. Several bar codes are available, including Code 3 of 9, Industrial 2 of 5, Interleaved 2 of 5, UPC A, EAN 8, EAN 13, UCC/EAN-128, UPCE, Royal Mail, Postnet 11.3 cpi, and Postnet 4 cpi.

2 HP PCL-II

Introduction

This chapter describes the HP® PCL-II emulation host control codes that are supported for your 5525B/31/32 Series printer. Emulation refers to the ability of a printer to execute the commands of a particular printer control language. A printer control language is the coding system used to convey, manipulate, and print data. It contains character codes and command sequences that configure the emulation. In this manual, the terms emulation, printer protocol, and printer control language are synonymous.

In the HP PCL-II emulation mode, your printer can print files coded for the HP PCL-II printer control language. To select the PCL-II emulation mode as the active printer emulation, select PCL-II in the ACTIVE EMULATION menu and then the PCL-II menu will appear under the EMULATION menu, as described in the *Compaq 5525B/31/32 Line Matrix Printer User's Manual*.

The PCL-II emulation provides many configurable parameters. The default parameter values for this emulation are shown in Table 1. You can modify the emulation parameter values in two ways:

- The PCL-II host control codes. An extensive set of PCL-II control code commands can be sent to the printer from an attached host computer via the host data stream. Most of this chapter is devoted to describing the PCL-II control code commands.
- The printer configuration menus. You can modify a subset of the PCL-II emulation parameters using the printer configuration menus and control panel keys as described in the *Compaq 5525B/31/32 Line Matrix Printer User's Manual*.

A parameter value set by a host control code overrides a value set from the printer's control panel.

NOTE: Configuration values selected from the menus or via host control codes can be saved to memory so that they will not be lost when you power off the printer. The menu selection for saving a configuration to memory is described in the *Compaq 5525B/31/32 Line Matrix Printer User's Manual.*

HP PCL-II Emulation Default Settings

The factory settings for the PCL-II emulation menu options are shown in Table 1. Host control codes can override the settings for these menu options.

Table 1. PCL-II Menu Option Factory Settings

Parameter	Default Setting
Primary/Secondary Character Set	
ID	0
Symbol Set	Roman-8(8U)
Pitch	10.0 cpi
Density	Data Processing
Page Length Representation	Inches/Page
Graphics Density	60 dpi
Perforation Skip	Disable
Display Functions	Disable
LF after CR	Disable
CR after LF	Enable
CR after FF	Enable
CR after VT	Enable
PTX Linefeed	Disable
LPI Adjust	6 LPI
Page L. /Lines	66 lines
Page L. /Inches	11 Inches

Switching Between the Emulations

The printer supports four emulations: PCL-II (the default), LinePrinter Plus, Code V™ and IGP®/PGL®. The LinePrinter Plus has three protocols from which to choose: P-Series, Proprinter III XL, and Epson FX-1050.

You can switch between PCL-II and any of the LinePrinter Plus protocols by sending one of the following commands:

ESC%-00000X	Switches from PCL-II to P-Series
ESC%-00001X	Switches from PCL-II to Proprinter III XL
ESC%-00002X	Switches from PCL-II to Epson FX-1050
SFCC|};K0	Switches from any of the LinePrinter Plus emulations to PCL-II

NOTE: The SFCC is the Special Function Control Code. From the P-Series protocol, this code is selectable from the front panel. The default value is hex 01. For the Proprinter and Epson emulations, the SFCC is always the ESC (hex 1B) character.

Configuring the PCL-II Emulation with Control Codes

The remainder of this chapter describes the PCL-II printer control language codes that may be sent from a host computer attached to the printer.

The escape (ESC) control code is used to select most of the programmable features.

Commands and control codes sent from a host system override settings in the configuration menus. However, any configuration settings from host control codes will be gone once the printer is powered off (or reset to the default values). Host control codes are *never* reflected in the PCL-II configuration menu. In order to save a configuration, it is necessary to select the desired options from the front panel and save the options to one of the printers eight user-selectable configurations. The *User's Manual* describes the menu option for saving changes to the printer memory.

Printer Feature Set Compatibility

PCL-II standardizes printer features and user access of these features, providing compatibility between HP printers. PCL-II is structured in five feature levels:

- Level I Print and Space
- Level II EDP
- Level III Word Processing
- Level IV Page Formatting
- Level V Enhanced Page Formatting

Each PCL level supersedes features of the levels below it. The 5525B/31/32 printers are Level II printers, meaning that all applications for Level I and II printers will operate correctly on your printer with no modifications.

In addition to supporting Level I and Level II features, the printer supports a limited set of additional features that may not be supported by other HP products. Applications written using these additional features may not operate as intended on other Hewlett-Packard printers which do not have these capabilities.

General Information

Programmatic Printer Control

Control codes and multi-character escape sequences are used to control the printers.

The printers execute command parameters in the order they are received. Therefore, the order of the parameters is significant. Unrecognized escape sequences are ignored in their entirety and may cause erroneous printing since the printer may be unable to perform the requested operation.

Logical and Physical Pages

The limits of the logical page determine the area in which printing can take place. Logical page length is set programmatically (in lines per page). Physical page length is set via the control panel and indicates the actual size of a single page. The physical page length cannot be changed programmatically. Refer to the *User's Manual* for more information.

Table 2. Control Codes

Function	Symbol	Binary	Level	Description
Backspace	BS	1000	II	Move one column left.
Horizontal Tab	HT	1001	V	Move the current active position to the next tab stop on the current line. The tab stops are at the left margin and every 8th column between the left and right margins. If new position crosses the right margin, the new position is set to the right margin.
Line Feed	LF	1010	I	Move to next print line while maintaining current column position
Form Feed	FF	1100	I	Move to first line at top of the next page while maintaining current column position
Carriage Return	CR	1101	I	Move to the left margin on current print line
Shift Out	SO	1110	I	Select following characters from the current secondary character font until receipt of a Shift In
Shift In	SI	1111	I	Select following characters from the current primary character font until receipt of a Shift Out
Escape	ESC	11011	I	The following characters are a special control sequence

Escape Sequences

An escape sequence consists of the ESC control code followed by one or more characters in succession. Both two-character and structured escape sequences control the printer. Two-character escape sequences take the form ESCX, where X is a character from the ASCII table (0 through ~). Structured escape sequences take the following form:

ESCXy[parameter]Z

This sequence is explained below:

ESCXy	**Prefix.** This part of the escape sequence indicates that the escape sequence is structured and also specifies which type of control is being performed. “X” is referred to as the structured character; “y” is referred to as the group character.
Parameter	This string of ASCII characters specifies a value (either numeric or alphanumeric).
Z	**Terminator.** This ASCII character indicates the function to which the previous parameter value applies. If this character is lower case (a,b,c, etc.), it indicates a combined escape sequence, meaning that more structured information will follow. If the character is upper case (A,B,C, etc.), it terminates the escape sequence string.

NOTE: Brackets [ ] are shown in many of the escape sequences for clarification purposes, but are not actually part of the escape sequence. For example, the brackets in the escape sequence for selecting page length (ESC&l[1-128]P) specify a range of values (1 through 128) for page length. To specify a page length of 35 lines, the escape sequence ESC&l35P would be sent to the printer.

Combining Escape Sequences

Structured escape sequences can be combined to save keystrokes. Combining sequences involves adding the parameter value and terminator of one or more sequences to another escape sequence. Structured sequences can be combined only if their prefixes are identical. When a parameter/ terminator of one sequence is added to another sequence, all of the terminators except the last should be lower case. For example, to set the left and right margins using two separate escape sequences, the following two sequences would be sent:

Set left margin at position 10	ESC&a10L
Set right margin at position 99	ESC&a99M

Using one combined escape sequence, the following would be sent to the printer:

ESC&a10l99M

Table 3 lists the escape sequences you can use with the printer. Note that the brackets [ ] used in these escape sequences are for clarification purposes only (the brackets are not actually part of the commands).

Table 3. Line Printer Escape Sequences

Escape Sequence	Explanation	Page No.
PCL LEVEL I		
ESCE	Software reset	18
ESCY	Display mode on	26
ESCZ	Display mode off	26
ESCz	Self test	26
ESC*rA	Raster graphics start	41
ESC*b[#]W[data]	Raster graphics data	41
ESC*rB	Raster graphics end	41
ESC&d[DEFGLMNOTUVW\}^]	Underline mode on	42
ESC&d[@CHIJKPQRSWXZ[]	Underline mode off	42
ESC&11L	Perf skip mode on	38
ESC&10L	Perf skip mode off	38
ESC&k[0,2]S	10 and 16.67 cpi	26
PCL LEVEL II		
ESC[(,)] [#ID]	Primary/Secondary font symbol set	19
ESC[(,)]s[*Cpi*]H	Primary/Secondary font cpi	22
ESC&1[6,8]D	6/8 lpi	26
ESC&1[1-128]P	Page length in lines	37
ESC&1[1-128]F	Text length in lines	38
ESC&a[*print position*]L	Left margin set	39
ESC&a[*print position*]M	Right margin set	39
ESC&p[#]X	Transparent mode	39
ESC&a[#]R	Move to absolute row position	40
ESC&a[#]C	Move to absolute column position	40
ESC&a[+#]R	Move to relative row position	40
ESC&a[+/-#]C	Move to relative column position	40

Table 3. Line Printer Escape Sequences (continued)

Escape Sequence	Explanation	Page No.
PCL LEVEL III		
ESC[(,)]s[0,1]S	Italics for primary/secondary font	22
ESC[(,)]s[0,1,-1]Q	Density for primary/secondary font	22
ESC&k4S	12 cpi selection	26
ESC*t[70,140]R	Raster graphics vertical and horizontal dpi selection	41
ESC*r[60,70,120,140]L	Raster graphics horizontal dpi selection	41
ESC*r[72,144]V	Raster graphics vertical dpi selection	41
ESC&10V	Move to TOF of physical page, VFC channel 0.	27
ESC&1[1-16]	Select VFC channel	29
ESC&1[*#bytes*]W[*data*]	Program VFC	29
ESC*z[#]H	Bar code height	43
ESC*z[#]Q	Bar code PDF position	43
ESC*z[#]V	Bar code type selection	43
ESC*z[*<bar data>*]Z	Bar code data	43
ESC*b[#]Y	Move # raster lines	41
ESC&k8S	Double size print mode on	26

Programmable Reset

The programmable reset escape sequence (ESCE) causes the printer to eject paper to the top-of-form (position 0,0) if not already at top-of-form. This command resets all current printer configuration values to the following states. The printer remains on-line after a programmable reset. When the printer is reset, it is set to a known state as follows:

- Primary and secondary character sets (fonts) as configured from the control panel.
- Vertical line spacing (6/8 LPI) as configured from the control panel.
- Paper moves to the next Top of Form position (if not currently at Top of Form).
- Data buffer is printed and then the buffer is cleared.
- Standard VFC channel assignments selected as defined by physical page length.
- Margins set at maximum limits and/or Left margin set at first column (0).
- Physical page length remains as configured from the control panel.
- Logical page length = physical page length
- Text length = logical page length minus one inch
- All character font attributes (symbol set, pitch, style, and density) default to the character font configured from the control panel.
- Display functions off and Underline enhance disabled.
- Perforation skip mode as configured from the control panel.
- Enable/Disable Label Card as configured from control panel.
- Printronix linefeed emulation as configured from control panel.
- Raster graphics horizontal resolution as configured from the control panel. Vertical resolution set to 72 dots per inch.

Character Font Selection

The printer can print several different character sets (fonts). By performing a printer self-test, you can see which fonts are installed in your printer. You may specify any of these fonts from an application. On the self-test printout, each available character font is printed along with a parameter number to the left of the printed font.

There are two ways to select a font from those available:

- By entering the parameter number via the control panel (function 1 = primary character set; function 2 = secondary character set)
- By specifying the attributes of the desired fonts using escape sequences.

The list below contains the font attributes, listed in order of descending priority:

- Symbol Set (ASCII, Roman-8, Line Draw, etc.)
- Pitch (10,12,13.3,15,16.67, 20)
- Style (Upright/Italic)
- Density (High-Speed, Near Letter Quality)

The attributes are specified for both primary and secondary fonts so that you may switch between the primary and secondary fonts using the Shift Out (SO) and Shift In (SI) control codes. Notice that the only difference between the primary and secondary font escape sequences is the direction of the parentheses. The left parenthesis “(“ is used for primary fonts and the right parenthesis “)” for secondary. Upon receiving these font attribute commands, the printer selects the best fitting font from those available.

It is not necessary to specify all four font attributes when selecting a font. If any of the attributes are not specified, the printer defaults to those attributes last specified (or, if none have been specified, from the control panel default font). For example, if you wish to select a font without selecting a print pitch, the print pitch last specified will be in effect. If you had not previously specified a print pitch, the printer will use the print pitch of the default font that was last specified from the control panel (provided that the particular symbol set selected is available in the current pitch).

The escape sequences used for specifying the character font attributes are explained in the following paragraphs.

Symbol Set Selection

The printer allows you to select a symbol set. A symbol set is a set of characters that are mapped to certain locations in the printer's memory. Symbol sets differ from one another in the characters contained in the set and in their locations within memory. The default symbol set is that of the default font specified from the control panel.

The following escape sequences are used to specify the primary and secondary symbol sets:

ESC(ID Select symbol set for primary character font

ESC)ID Select symbol set for secondary character font

Table 4 lists the ID's needed to select each symbol set. For example, to select the Roman-8 symbol set for the primary font, you would send the ESC(8U escape sequence. To select OCR-B for the secondary font, you would send ESC)1O to the printer.

An ASCII symbol set table is provided in Appendix A.

NOTE: Any number of fonts may be printed on each line, but to do this, each font must be the same pitch and typeface. That is, only one print pitch, or typeface is allowed per line.

Table 4. Symbol Set Selection

Symbol Set Name	ID	Classification	Printable in hex 80-9F Range	Mode
Roman-8*	8U	8-Bit	No	1
Turkish-8	8T	8-Bit	No	1
Arab-8	8V	8-Bit	No	1
Cyrillic-8	8R	8-Bit	No	1
ASCII	0U	7-Bit	No	0
Math Symbol	0A or 0M	7-Bit	No	0
Line Draw Set	0B or 0L	7-Bit	No	0
ISO Den/Nor	0D	7-Bit	No	0
Roman Ext Char	0E	7-Bit	No	0
ISO UK	1E	7-Bit	No	0
ISO France	0F	7-Bit	No	0
ISO German	0G	7-Bit	No	0
Hebrew	0H	8-Bit	No	1
Japan ASCII	0K	7-Bit	No	0
Katakana	1K	8-Bit	No	1
Block Char	1L	7-Bit	No	0

Table 4. Symbol Set Selection (continued)

Symbol Set Name	ID	Classification	Printable in hex 80-9F Range	Mode
OCR-A	0O	7-Bit	No	0
OCR-B	1O	7-Bit	No	0
ISO Swe/Fin	0S	7-Bit	No	0
ISO Spain	1S	7-Bit	No	0
ISO Italian	0I	7-Bit	No	0
ISO Portugu	4S	7-Bit	No	0
Latin-1	0N	8-Bit	No	1
Latin-2	2N	8-Bit	No	1
Latin-5	5N	8-Bit	No	1
Latin-6	6N	8-Bit	No	1
Baltic	19L	8-Bit	No	1
PC-8 DanNor	11U	8-Bit	Yes	2
PC-8 Code 437	10U	8-Bit	Yes	2
PC-850 MtLi	12U	8-Bit	Yes	2
PC-851 Lt/Gk	12G	8-Bit	Yes	2
PC-852 Lat2	17U	8-Bit	Yes	2
PC Turkish	9T	8-Bit	Yes	2
PC Hebrew	15H	8-Bit	Yes	2
PC Lat/Ara	10V	8-Bit	Yes	2
PC Cyrillic	3R	8-Bit	Yes	2
Win 3.1 Latin-1	19U	8-Bit	Yes	2
Win 3.1 Latin-2	9E	8-Bit	Yes	2
Win 3.1 Latin-5	5T	8-Bit	Yes	2
Math-8	8M	8-Bit	No	1
PS Math	5M	8-Bit	No	1
Greek-7	12N	8-Bit	No	1
Postnet 4	15Y / 0K	7-Bit	No	1
Postnet 11.25	1K	7-Bit	No	1
Greek-8	8G	8-Bit	No	1
Hebrew-8	8H	8-Bit	No	1
Katakana-8	8K	8-Bit	No	1

Printing in the Hex 80 through Hex FF Region

The printer exhibits different behaviors as it processes characters in the hex 80 through FF range. Behavior is based upon the symbol set of the active font. If the symbol set of the active font is 7-bit, characters in the hex 80 through FF range will be ignored. If the symbol set is 8-bit, the printer will attempt to process the characters.

There are two different types of 8-bit sets. Some have characters that are printable in the hex 80 through 9F region, while others do not. (See Table 4). If the active symbol set does not have printables in the hex 80 through 9F range, the characters are ignored.

To determine symbol set properties, perform a symbol set print from the PCL menu. 7-bit sets print only one line of characters, while 8-bit sets print two. 8-bit sets, with printables in the hex 80 through 9F range, print characters in the space below the control code on the first line. Those without printables in that range leave the area under the control codes blank.

Print Pitch Selection

Print pitch is specified using the following escape sequences:

ESC(s[5,10,12,13.3,15,16.7,20.0]H
Select print pitch for primary character font

ESC)s[5,10,12,13.3,15,16.7,20.0]H
Select print pitch for secondary character font

When specifying a pitch, if no font with the exact size specified is available, the next larger pitch will be designated. If a larger pitch does not exist, the pitch will be set to 16.67. Only one pitch per line may be selected. The default print pitch is that of the primary font specified from the control panel.

NOTE: Refer to the *User's Manual* to see which pitches are available for different symbol set and typeface combinations.

Character Style Selection

The printer has two types of character styles: upright and italic. The following escape sequences select either the upright or the italic print style for the primary and secondary character fonts:

ESC(s0S Selects the upright style for the primary font

ESC(s1S Selects the italic style for the primary font

ESC)s0S Selects the upright style for the secondary font

ESC)s1S Selects the italic style for the secondary font

Italics cannot be selected or saved from the control panel. The printer will default to the upright style when the printer is first powered on. Changing emulations, loading a configuration, or sending the ESCE command to the printer will cancel the italic style for the primary and secondary fonts.

Character Density Selection

(PCL Level III)

Standard-density print, high-density print, and high-speed draft printing can be specified using the following escape sequences:

Primary Selection

ESC(s0Q Select Standard-Density (12 x 9 dot matrix, 120 x 72 dpi) for the primary font

ESC(s1Q Select High-Density (18 x 12 dot matrix, 180 x 96 dpi) for the primary font

ESC(s-1Q Select High-speed Draft Printing (12 x 6 dot matrix, 120 x 48 dpi) for the primary font

Secondary Selection

ESC)s0Q Select Standard-Density (12 x 9 dot matrix, 120 x 72 dpi) for the secondary font

ESC)s1Q Select High-Density (18 x 12 dot matrix, 180 x 96 dpi) for the secondary font

ESC)s-1Q Select High-speed Draft Printing (12 x 6 dot matrix, 120 x 48 dpi) for the secondary font

The default density is that of the default font specified from the control panel. If the symbol set selected is not available in the requested density, the printer will print blank space. However, OCR-A, OCR-B, and Postal Barcodes force density changes to ensure scanability.

When draft printing is selected, the printer prints less dots vertically (5 dots). This reduction in dots results in an increase in print speed of up to 30%.

For example, to cue high-density ASCII:

ESC(0UESC(s1Q

To cue high-speed draft with Roman Extension:

ESC(0EESC(s-1Q

The following table lists all the Symbol Sets available to the PCL II Emulation. Each Symbol Set is followed by its selection Code, and the Densities(Pitches) that it is available in. With the exception of OCR-A and OCR-B, selecting a symbol set in a Density combination not listed in the chart below will result in spaces being printed in place of the desired character.

Table 5. Available Symbol Sets

Name	Code	Density (Pitches)
Roman-8	8U	HS DP NLQ
Turkish-8	8T	HS DP NLQ
Arab-8	8V	HS(5,10) DP NLQ
Cyrillic	8R	HS(5,10) DP NLQ
ASCII	0U	HS DP NLQ
Math Symb	0A/0M	HS DP NLQ
Line Draw Set	0B/0L	DP
ISO Den/Nor	0D	HS DP NLQ
Roman Ext	0E	HS DP NLQ
ISO UK	1E	HS DP NLQ
ISO France	0F	HS DP NLQ
ISO German	0G	HS DP NLQ
Hebrew	0H	HS DP NLQ
Japanese ASCII	0K	HS DP NLQ
Katakana	1K	DP(5,10) NLQ(5,10)
Block Char	1L	DP
OCR-A	0O	OCRA(10)
OCR-B	1O	OCRB(10)
ISO Swe/Fin	0S	HS DP NLQ
ISO Spain	1S	HS DP NLQ
ISO Italian	0I	HS DP NLQ
ISO Portugu	4S	HS DP NLQ
Latin-1	0N	HS DP NLQ
Latin-2	2N	HS DP NLQ
Latin-5	5N	HS DP NLQ
Latin-6	6N	HS DP NLQ
Baltic	19L	HS DP NLQ
PC-8 DanNor	11U	HS DP NLQ
PC-8 Cd 437	10U	HS DP NLQ
PC-850 MtLi	12U	HS DP NLQ
PC-851 LtGk	12G	HS DP NLQ

Table 5. Available Symbol Sets (continued)

Name	Code	Density (Pitches)
PC-852 Latin2	17U	HS DP NLQ
PC Turkish	9T	HS DP NLQ
PC Hebrew	15H	HS DP NLQ
PC Lat/Ara	10V	HS(5,10) DP NLQ
PC Cyrillic	3R	HS DP NLQ
Win3.1 Lat1	19U	HS DP NLQ
Win3.1 Lat-2	9E	HS DP NLQ
Win3.1 Lat-5	5T	HS DP NLQ
Math-8	8M	DP NLQ
PS Math	5M	DP NLQ
Greek 7	12N	HS DP NLQ
Postnet 4	15Y	NLQ(4)
Postnet 11.3	1K	NLQ(11.25)
Greek-8	8G	HS DP NLQ
Hebrew-8	8H	HS DP NLQ
Katakana-8	8K	DP(5,10) NLQ(5,10)

NOTE: All fonts support the following pitches unless otherwise noted: (5, 10, 12, 13.3, 15, 16.67, 20).

Switching Character Fonts

Character fonts can be accessed using the Shift In/Shift Out (SI/SO) control codes.

The SO (CTRL N) control code is sent to the printer to access the secondary font; the SI (CTRL O) control code is sent to select the primary font.

Display Functions Mode

(PCL Level I)

The display functions mode can be entered using the ESCY sequence. In the display functions mode, the printer prints representative character symbols for the control code characters instead of actually executing the control characters. In this mode, the carriage return (CR) control character will cause a CR symbol to be printed and an actual carriage return and line feed to be performed. The display functions mode can be exited by sending an ESCZ sequence. The ESCZ will be printed before the mode is terminated. Display Functions Mode “off” is the printer default state.

NOTE: The system driver may only allow the printer to print one line in the display functions mode.

When the printer is printing in high-speed draft mode, display function characters will not be printed.

Self-test

(PCL Level I)

ESCz prints the PCL-II configuration report, which shows available character sets, symbol sets, bar codes, etc.

Print Mode Selection

The standard, compressed, and double-high/double-wide print modes are selected using the ESC&1[0,2,4,8]S sequence as shown in the following table. This escape sequence affects both the primary and secondary character fonts. The default print mode is that of the default font specified from the control panel. Only one print mode is allowed per line.

Table 6. Print Mode Selection

Mode	Horizontal Pitch (in characters/inch)	Vertical Pitch (in lines/inch)*
0	10.0	6 or 8
2	16.67	6 or 8
4	12.0	6 or 8
8**	5.0	3 or 4

* Dependent on current line spacing.

** Double high/double wide character set selection.

Line Spacing

Vertical line spacing of 6 or 8 LPI (lines per inch) can be selected either from the control panel or remotely using the ESC&l[6 or 8]D sequence. When the printer is reset, the vertical line spacing is as set from the control panel. If a parameter other than 6 or 8 is entered, the command is ignored and no line spacing change is made.

NOTE: Changing the line spacing causes the standard VFC table to be recalculated.

Vertical Forms Control (VFC)

Vertical forms control (VFC) is a feature which allows increased throughput by enabling the printer to skip to predetermined print locations. Key page locations, such as top of form, half form, double space, and triple space, are referred to as channels (0 through 16) and are stored in a VFC “table.”

The printer has both a standard (computed) VFC and a programmable VFC. The following paragraphs explain each in more detail.

NOTE: In most situations, the printer's standard (computed) VFC page length setting, as determined from the front panel, meets the application requirements. Refer to the *User’s Manual* for information on setting the page length from the front panel.

Standard (Computed) VFC

The printer VFC uses the logical page and form length (text length) to calculate the distance to be skipped for each VFC channel. This information is then loaded into the printer's VFC “table.” The “table” is 16 channels wide and *n* lines long, where *n* is the logical page length in number of lines. A VFC channel contains a 1 in this table on every line it can access. If the VFC channel cannot access the line, a 0 is placed on that line for that channel. For example, to specify a skip to the next half form, a program would specify VFC channel 6. Notice in the sample on page 35 that 1's are placed in the table at the half form position (lines 1 and 9). Then, for example, if the printer has finished printing line 2 and channel 6 is selected, the paper will be advanced to line 9.

To use the standard VFC, perform the ESC&l[0 through 16]V sequence using the appropriate parameter number listed in Table 7.

Table 7. VFC Default Channel Definitions

Prefix	Parameter	Terminator	Explanation
ESC&l	0	v/V	*Conditional Top of Physical Page
	1		Top of Form (first line of text)
	2		Bottom of Form (last line of text)
	3		Single spacing
	4		**Double spacing
	5		**Triple spacing
	6		Half form
	7		Quarter form
	8		Tenth line
	9		Bottom of Form
	10		Bottom of Form - 1
	11		Top of Form - 1
	12		Top of Form
	13		Seventh line
	14		Sixth line
	15		Fifth line
	16		Fourth line

*All escape sequences except ESC&l0V refer to the logical page rather than the physical page. This escape sequence causes a skip to the top of the next physical page (unless already at top of page).

**These channels cause a move to the next double/triple space line, and therefore may not actually perform a double/triple space.

Programmable VFC

Programmable VFC allows the user to specify paper movement information other than the standard VFC definitions shown in Table 7. VFC information is stored in the memory (RAM) table just as the standard VFC is, only the bytes of information are loaded into RAM using the following escape sequence:

ESC&l[*byte count*]W[*VFC data*]

The *byte count* parameter specifies the number (in decimal 0 - 255) of VFC data bytes to expect immediately following the termination of the escape sequence.

NOTE: An even byte count must be indicated. If an odd byte count is indicated, the VFC table in RAM will not be overwritten and the data bytes following the ESC sequence will be read and discarded.

VFC data is the binary data which is loaded into the VFC table in RAM. These 8-bit bytes are sent in the following order following the ESC sequence terminator: the most significant byte of the first word followed by the least significant byte of the first word, followed by the most significant byte of the second word, etc. The most significant bit of each word is channel 16 and the least significant bit of each word is channel 1.

VFC Data = (MS byte) (LS byte) (MS byte) (LS byte) . . .

(word 1 = line 1) (word 2 = line 2) . . .

Once the VFC has been loaded into the RAM table, the VFC channels are selected using the ESC&l[0 through 16]V sequence in the same manner as the standard VFC. The standard and programmable VFC both use the same table in RAM. Resetting the printer causes the standard VFC to be recalculated using the current page and text (form) length and a new table to be overwritten in RAM. The VFC table is also recalculated when the line spacing, text length, or page length changes.

NOTE: If the I/O is configured for 7 bit data, channels 8 and 16 cannot be downloaded with confidence since the eighth bit is used for the communication protocol. Selecting channels 8 or 16 for 7 bit data is not recommended.

Special VFC Considerations

Before loading a VFC table, it is recommended that a VFC select of channel 0 be performed. This will bring the printer to the top of the physical page.

When a programmed VFC is loaded into RAM, the logical page length is automatically calculated using the following formula:

Logical Page Length (in number of lines) = *byte count /2*

The example on page 35 shows a VFC table which uses “standard” VFC definitions and also illustrates a programmable VFC.

Example: Defining a 3.5 inch form at six lines per inch.
1 inch = 6 lines x 3.5 inches = 21 lines

Programmable VFC Using PCL

Programmable VFC's using PCL seem to cause a lot of problems and misunderstandings. Most of the misunderstanding concerns the use of the escape sequence used to set the VFC file. This escape sequence is used to override the default VFC of the printer. This escape sequence can be hard-coded into a program or ASCII file.

VFC's are best understood by reviewing an actual example of how to implement them. For this discussion, the example consists of a 3.5 inch form at six lines per inch with several different channels defined for use on the form to be printed.

1 inch = 6 lines per inch x 3.5 inches = 21 lines; therefore this would be a 21 line form.

NOTE: The TEXT LENGTH command could be used in conjunction with the standard VFC and accomplish the above requirements. The assumption is there are reasons to use a customized VFC; this example has been simplified for clarification purposes.

First, establish the VFC length: with a 3.5" form and 6 LPI print, we have 21 potential lines of print (3.5 x 6 = 21). Refer to the following figure for an example of the desired finished output.

There are many methods to accomplish this task. The simplest way is to provide a "1" in CH3 (Channel 3) for all possible print lines and simply call CH3 for each line (including blank lines). This is called "line counting" and leaves the burden of positioning with the programmer (adding or deleting a line causes an adjustment elsewhere to be made).

EXAMPLE FORM

Line 1	Company name
Line 2	Street address
Line 3	
Line 4	
Line 5	
Line 6	
Line 7	Opening line
Line 8	
Line 9	
Line 10	Body
Line 11	Body
Line 12	Body
Line 13	
Line 14	
Line 15	
Line 16	
Line 17	Closing line
Line 18	
Line 19	
Line 20	P.S. line
Line 21	

A second method involves only providing a “1” in CH3 where print will occur. The programmer then simply calls CH3 and the blank lines are skipped. There still is no flexibility for adding or deleting lines without VFC modification, but line counting is minimized.

A third method involves assigning VFC channels to each section of the letter and performing a call to CH3 within each section. To do this, the manufacturer highly recommends following these guidelines:

- CH1 should always define TOF and must be present for a valid load.
- CH2 should always define BOF allowing for vertical margin (if any) and must be present for valid paper out conditions.
- CH3 should be present for any potential print line except in the vertical margin area (if any).

For this example, CH1 will occur at line 1 and is aligned with the Company Name. We will arbitrarily assign CH4 to occur at line 7 (Opening Line), CH5 to occur at line 10 (Body), CH6 to occur on line 17 (Closing Line) and CH7 to occur on line 20 (P.S. Line).

With the above channel assignments in mind, the programmer would call CH1 to begin the letter. After printing the name and address (using calls to CH3 to “move” to each line) the programmer would call CH4 to skip to line 7 and print the opening line. Next, a call is made to CH5 to skip to line 10 and print the body, CH6 to print the closing and CH7 to print the P.S. line. This gives each section flexibility by allowing variable sizes, limited by the physical room available before interfering with the next section and avoiding the drudgery of line count.

The above VFC would look like:

```
Channel   1   2   3   4   5   6   7   8   9   10 11 12 13 14 15 16
Line 1    1       1
Line 2            1
Line 3            1
Line 4            1
Line 5            1
Line 6            1
Line 7            1   1
Line 8            1
Line 9            1
Line 10           1       1
Line 11           1
Line 12           1
Line 13           1
Line 14           1
Line 15           1
Line 16           1
Line 17           1           1
Line 18           1
Line 19           1
Line 20           1               1
Line 21       1   1
```

NOTE: A “1” corresponds to a hole punched in a physical paper tape.

Notice that for each line channel 3 is selected, this would select a single space advance. A 1 could be placed in any or all other channels and the VFC would still be valid since the printer will only look at the channel selected and advance to the next line that contained a 1 in that channel. For example, if the printer was on line 2 and channel 7 was selected, the printer would advance or slew down to line 20 which is the first line where there is a “1” in channel 7.

The next step would be to convert the above VFC definition into the escape sequence format. The VFC data portion of the escape sequence reverses the order of the channels. Once reversed, the 16 bits are then divided into two, 8-bit bytes, with channel 16 being the Most Significant Bit (MSB) of the word and channel 1 the Least Significant Bit (LSB) of the word. Refer to Table 8.

Since the escape sequence requires the VFC data to be in ASCII format this binary data must be converted to ASCII. As in our example, many characters may convert to “unprintable” ASCII characters (below ASCII OCTAL 037). Refer to the ASCII Symbol Set chart in Appendix A. Entering unprintable data can be done in several ways:

The easiest and preferred method involves using “dummy” VFC channels to cause the converted character to become a printable one. For example, always have bit 7 and bit 15 a “1”, thus adding %100 to the unprintable character, and eliminating the confusion of entering unprintable data. Do not “call” the corresponding channel bit 7 or 15 or else improper spacing will occur.

If the VFC channels that bits 7 and 15 represent must be used, these unprintable characters must be manipulated for data entry. In most cases, this can be dealt with by using the DISPLAY FUNCTIONS mode of your terminal. Type in the “ESC&l[*byte count*]W” followed by the ASCII characters using the CONTROL key with the corresponding letter. (Since the CONTROL key subtracts %100 (100 OCTAL) simply add %100 to the “unprintable” character. For example, 00000101 converts to %5, adding %100 gives you a %105 which is an E, therefore, pressing a CONTROL E gives the desired result.)

If your terminal doesn't have a DISPLAY FUNCTIONS mode, some EDITOR programs allow entering the OCTAL equivalents. Some editors do not allow the user to directly enter OCTAL numbers. In this case, a “dummy” character would be entered as the VFC data. Next, the EDITOR “CHANGE” command would be used to change the dummy character to the desired ASCII character. For example, place an “x” as a dummy character in the VFC data and use the CHANGE command to replace the “x” with an ASCII 01 (SOH character) by typing “CHANGEQ “x” to ‘01”. This would replace the “x” with the unprintable ASCII 01; your escape sequence would appear one character shorter without DISPLAY FUNCTIONS mode turned on.

This could also be accomplished by changing the specific column to the ASCII character required. It is important to specify the starting and stopping column or the CHANGE command will act as a column INSERT. For example, if column 10 on line 2 is to be changed to an ASCII 04 you would type “CHANGEQ 10/10 TO '04 IN 2”.

NOTE: The “ ' ” is the single quote and not the prime character.

There are several methods to enter data in the Workstation Configurator:

- Entering data as a decimal number, i.e. 13 for a carriage return.

- As an OCTAL number (one byte at a time) by preceding the number with the % sign.
- As a two or three character mnemonic such as BS or DC1 (see Appendix B of the Workstation Configuration manual).
- By entering the control characters with the up-arrow or circumflex character preceding the character, i.e. a backspace would be an ^H.
- By entering the actual ASCII character within single quotes, i.e. ’A’ would equate to an OCTAL %101.

Each character entered, with the exception of multiple ASCII characters within the single quote, MUST BE separated by commas. An example would be “ESC, '&16W', %101, 'ABC', BS, 13”.

NOTE: Only one byte may be specified at a time in OCTAL, thus allowing a maximum of OCTAL 377 which would place a 1 in columns 1-8.

Table 8. Converting VFC Format to VFC Data

	Most Significant Byte								Least Significant Byte										
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Octal	ASCII	CTL
																	MSB/LSB	MSB/LSB	MSB/LSB
Line 1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	%000%005	NulEnq	@E
Line 2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 7	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	%000%014	NulFF	@L
Line 8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 10	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	%000%024	NulDc4	@T
Line 11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 12	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 13	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 17	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	%000%044	Nul$	**@$***
Line 18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	%000%004	NulEot	@D
Line 20	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	%000%104	NulD	**@D***
Line 21	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	%000%006	NulAck	@F

* DO NOT depress the Control Key on these **BOLDFACE** characters since they are printable characters.

This VFC data can now be entered into the escape sequence in an ASCII file or a program and can either be embedded into the application or merged with the spool file.

Example VFC Data Entry Methods

The example escape sequence may be created while the DISPLAY FUNCTIONS key has been enabled as shown below.*

Top of Form
Bottom of Form
Single Spacing
Double Spacing**
Triple Spacing**
Half Form
Quarter Form
Tenth Line
Bottom of Form
Bottom of Form - 1
Top of Form - 1
Top of Form
Seventh Line
Sixth Line
Fifth Line
Fourth Line

Channels	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Line 1	1		1	1	1	1	1	1				1	1	1	1	1
Line 2			1													
Line 3			1	1												
Line 4			1		1											
Line 5			1	1			1									1
Line 6			1												1	
Line 7			1	1	1									1		
Line 8			1										1			
Line 9			1	1		1	1									1
Line 10			1		1											
Line 11			1	1				1							1	
Line 12			1													
Line 13			1	1	1		1							1		1
Line 14			1							1						
Line 15		1	1	1					1				1			
Line 16																
Line 17																
Line 18																
Line 19																
Line 20																
Line 21										1						

*This sample shows a 21-line VFC table at 6 LPI. The text ends at line 14, leaving 6 blank lines (one inch) at the bottom of the page.

**These channels cause a move to the next double/triple space line.

Press the CONTROL key before each letter of the VFC data except for the two BOLDFACE characters.

ESC&142W@E@D@D@D@D@D@L@D@D@T@D@D@D@D@D@**$**@D@D@**D**@F

VFC data

This would display the corresponding ASCII character, i.e., the Nul for CTL @.

Another method using a text editor would be to do a CHANGE command replacement to convert the characters to ASCII characters. This is shown as:

```
\ADD 1
1 ESC&142Wabcdefghijklmnopqrstuvwxyz ABCDEFGHIJ
2 //
\CHANGEQ 7/7 TO ’00
\CHANGEQ 8/8 TO ’05
\CHANGEQ 9/9 TO ’00
.
.
.
\CHANGEQ 48/48 TO ’06
```

This could also be input by not entering the letters, but simply changing the specific column to the desired ASCII character. In the above example the “abc... HIJ” would not be entered and the CHANGE command would be used as follows:

```
\CHANGEQ 7 TO '00 \CHANGEQ 8 TO '05
.
.
.
```

As you can see, the escape sequence for the Programmable VFC can be quite complicated. This should only be used after attempting to satisfy VFC requirements using the standard (computed) VFC and the TEXT and PAGE LENGTH escape sequences.

The most common errors in successfully implementing the Programmable VFC escape sequence usually involve improper VFC byte counting or attempting to manipulate “unprintable” characters and getting confused. Converting these “unprintable” characters to printable ones is the easiest way to avoid data entry confusion.

Summary of Recommended Steps to Implement Programmable VFC

1. Layout the required VFC in a standard channel 1-16 format.
2. Reverse the resulting bit image so that channel 1 is now where channel 16 was and channel 16 is now where channel 1 was.
3. Divide this 16 bit image into two 8-bit bytes.
4. Decode these 8-bit bytes into ASCII characters using the chart in Appendix A. If the corresponding decoded character is not a printable character (below %37), it is highly suggested to convert to one by using a “dummy” channel (7 and/or 15).
5. Enter these characters into the Programmable VFC escape sequence as the VFC data. This data MUST be an even byte count and is CASE SENSITIVE (upper/lower). As in all escape sequences, do not include the brackets ([ ]); they are for clarification only.

6. This escape sequence must be sent to the printer before the data by embedding in the application or as part of an initialization string. A programmable or hardware RESET will clear the VFC RAM causing the printer to return to the default VFC.

NOTE: If either the RS-232E or the RS-422B interface is installed in the printer, the interface can be configured to have such things as STRIP NULLS AND DELETES. The Null and/or Delete character could be used as valid characters, so the user must either combine other channels on the same line to generate another character, or not configure the printer to strip these characters. Another factor may be the use of 8-bit data. If the user desires to use channels 8 and 16, then 8-bit data must be configured. For more detail please refer to the *User's Manual*.

Logical Page Length Selection

(PCL Level II)

Two page length definitions exist for the printer; physical page length and logical page length. The physical page length is the length of the paper in inches. The printer also allows you to set page length in lines per page.

The logical page length is that which is received via an escape sequence and is calculated in lines per page. Therefore, one physical page can contain more than one logical page.

The default logical page length is the physical page length. In most cases, formatting problems can be solved by changing the physical page length and using the default logical page length.

NOTE: When loading a different size of form in the printer, it is usually best to have the operator set the physical page (from the control panel) to the actual size of the paper rather than programmatically setting the logical page to match the length of the new form (and leaving the physical page length at its previous value). This practice avoids problems if a paper-out occurs.

The logical page length is set using the ESC&l[1-128]P sequence, where the value field (1-128) is the desired number of lines per page. This command also defaults the text length to be one inch less than the logical page length, unless the logical page length is one inch or less, in which case the text length is set equal to the page length. Requests for a page length of zero cause the logical page length to equal the physical page length. Requests for a page length greater than 128 are ignored.

Although the logical page is specified in number of lines, this number represents the space occupied by that many lines (using the line spacing that was effective at the time the logical page length was specified). Therefore, if a logical page length of 66 lines is specified and the line spacing is currently at 6 LPI, the logical page length is 11 inches. If the line spacing is changed (to 8 LPI) in the middle of the page, the actual length of the page would still be 11 inches but the number of print lines would be 88 (8 LPI x 11 inches).

Before changing the page length, it is recommended that a VFC select of channel 0 be performed. This will bring the printer to the top of the next physical page (unless the printer is already at the top of the physical page).

Changing the logical page length changes the standard VFC table.

Text Length (Vertical Margin) Selection

(PCL Level II)

The length of a form within a logical page is set using the ESC&l[1-128]F sequence, where the number of lines desired (1-128) is specified. The first line of text is printed at the Top of Form position. The physical page length minus the text length defines the total vertical margin (top plus bottom margin) for the page.

If a text length of zero is received, the text length defaults to one inch less than the logical page length. The default text length, which is invoked any time the logical page length is changed, is one inch less than the logical page length. If the logical page length is one inch or less, the text length is set equal to the logical page length.

Perforation Skip Mode

(PCL Level I)

When perforation skip is enabled, the printer skips to the next Top of Form if the bottom margin is entered following a line feed. The following escape sequences enable and disable the perforation skip mode:

ESC&l1L	Enable perforation skip mode
ESC&l0L	Disable perforation skip mode

If a programmable VFC is enabled, the end of text is determined by the first occurrence of channel 2. If channel 2 is completely clear, the end of text is the end of the page (that is, there is no perforation region). The text length defaults to one inch less than the logical page length unless the text length has been specified with the ESC&l[1-128]F sequence.

Perforation skip mode defaults as configured from the control panel.

When the perforation skip mode is disabled, the printer will print in the margin space below the desired bottom of text. This can be avoided if a VFC select to the next Top of Form is performed immediately following the last desired line of text on the page.

NOTE: Many systems perform an automatic page eject which overrides the printer's perforation skip mode. If the user desires to print in the perforation skip region, the system's automatic page eject must be disabled.

Horizontal Margin Selection

Absolute left and right margin selection is accomplished using the following escape sequences:

ESC&a[*print position*]L Set left margin

ESC&a[*print position*]M Set right margin

The print position specified indicates a decimal number in the range 0 through 131 @ 10cpi (0 - 65 for Double-size, 5 cpi, 0-219 for compressed, 16.67 cpi). The print position represents the column using the print pitch active when the margin is set. For example, if the character pitch is 10 characters/inch and the left margin is set to column 20, the left margin will be two inches from the left physical limit of the printer. If the pitch is then changed to 5 characters/inch, the left margin would still be in the same logical position, but column 20 would be four inches from the left physical limit of the printer instead of 2 inches.

Margins can be set at any column, regardless of the present printing position. If the new margin selected is to the right of the current print position, then the new setting takes effect immediately. If the new margin setting is to the left of the current print position, then the new setting does not take effect until the cursor is reset to zero.

The first column within a line is designated column 0. If a print position greater (or less) than the printer's physical limit is specified, the right (or left) margin will be set to the limits of the printer. Power-on and set the margins to the maximum limits.

Commands are ignored if the result would place the left margin to the right of the right margin. The only way to move the current active position outside the margins is by using the escape sequences for horizontal cursor control.

To release the right margin use one of the following escape sequences:

ESC&a132M for 10 cpi

ESC&a158M for 12 cpi

ESC&a175M for 13.3 cpi

ESC&a198M for 15 cpi

ESC&a220M for 16.7 cpi

Transparent Print Data

This feature allows the printing of binary data which is required in certain applications. The escape sequence ESC&p[*# of bytes*]X enables the printer to print data as in the display functions mode, except that no control codes or escape sequences (including CR and ESCZ) are executed. The number specified in the value field is the exact number of bytes that will be interpreted as binary.

Cursor Control

Absolute and relative cursor control are provided for the printer. Cursor moves are made in the current active pitch and current active vertical spacing. The following escape sequences perform these functions:

Absolute Row	ESC&a#R Move cursor to absolute row # (where # is an unsigned integer)
Absolute Column	ESC&a#C Move cursor to absolute column # (where # is an unsigned integer)
Relative Row	ESC&a[+#]R Move cursor to relative row # from current position (where # is a signed [+ only] integer)
Relative Column	ESC&a[+/-#]C Move cursor to relative column # from current position (where # is a signed [+/-] integer)

NOTE: A plus (+) or minus (-) sign in front of the value indicates that the new position is relative to the current active position. A (+) sign means the new position is to the right (horizontal) or that paper motion is forward (vertical). A (-) sign means that the new cursor position is to the left of the current active position. The printer does not perform reverse paper motion.

The vertical cursor positioning commands move the current active position to the same column on a new line; the vertical movement is based on the active vertical spacing.

The horizontal cursor positioning commands move the current active position to a new column on the same line; the horizontal movement is based on the active horizontal print pitch.

The first column/row within a line/page is column/row zero. Therefore, the upper left-most position is position (0,0). This escape sequence ignores margins and can therefore be used to set the current active position to any location within the printer's physical limits. If a request is made for a location outside the printer's physical limits, the current active position is moved to the appropriate limit.

Raster Graphics

Graphics are sent to the printer using the following escape sequences:

ESC*t[70, 140]R	Raster graphics resolution
ESC*r#L	Horizontal raster graphics resolution
ESC*r#V	Vertical raster graphics resolution

The ESC*r#L and ESC*r#V escape sequences allow you to set the horizontal and vertical raster graphics resolutions independently. Valid raster graphics resolutions are 70 DPI by 72 DPI, 140 DPI by 72 DPI, 70 DPI by 144 DPI, and 140 DPI by 144 DPI. The following table lists the graphics resolution and the corresponding escape sequence used to select that graphics resolution. There are many different valid ways to select a given graphics resolution. The following table lists only one of the many valid ways.

The ESC*t#R escape sequence allows you to select a graphics resolution of either 70 x 72 dots per inch (default) or 140 x 144 dots per inch (high resolution). For example, to specify high-resolution, you would send the ESC*t140R escape sequence to the printer. Using the standard resolution, the maximum amount of graphics data that can be printed is 115.5 bytes versus 231 bytes for high-resolution.

Table 9. Graphics Resolution

Horizontal DPI	Vertical DPI	Escape Sequence
70	72	ESC*r70l72V
140	72	ESC*r140l72V
70	144	ESC*r70l144V
140	144	ESC*r140l144V

ESC*rA	Prepare for raster graphics (PCL Level I)
ESC*b[*# of bytes*] W[*binary data*]	Raster data transfer (PCL Level I)
ESC*b[*# of raster lines*]Y	Move paper # number of raster lines
ESC*rB	Raster graphics complete (PCL Level I)

The ESC*rA sequence informs the printer that a raster graphics dump is to follow the sequence. If the printer has received a partial line of ASCII data before this sequence is received, this escape sequence causes the ASCII data to be printed and a carriage return and line feed to be performed.

The ESC*b#W[binary data] sequence actually sends the raster data to the printer. This escape sequence must be sent for each raster line to be printed. The # of bytes parameter is the decimal number of bytes of binary graphics data to be sent to the printer. The binary data consists of a 1 for every dot to be printed and a 0 for every blank space.

The ESC*b#Y escape sequence allows you to skip multiple adjacent blank lines. The # of raster lines parameter is the decimal number of blank raster lines to skip. The size of the blank raster line to be skipped is equivalent to the currently set vertical raster graphics resolution. The advantage of using this escape sequence over sending multiple raster data transfer escape sequences containing blank raster lines is the escape sequence is processed faster and the paper is moved faster.

The ESC*rB sequence informs the printer that all the raster data has been transferred.

The following example illustrates how to send three lines of raster graphics to the printer.

ESC*rAESC*b2WDc

ESC*rA	Prepares printer for raster graphics
ESC*b2W	Indicates two bytes of data to follow
D	First byte of graphics data
c	Second byte of graphics data

ESC*b2WL@

ESC*b2W	Indicates two bytes of data to follow
L	First byte of graphics data
@	Second byte of graphics data

ESC*b2W$+ESC*rB

ESC*b2W	Indicates two bytes of data to follow
$	First byte of graphics data
+	Second byte of graphics data
ESC*rB	Raster graphics complete

Many systems perform an automatic line feed after each line of data. The system's automatic line feed must be suppressed or else the raster lines will not be adjacent to each other. A file equation which specifies the line length (for example, RESC=-219) may be used to suppress the automatic line feed along with carriage control directives, such as "+".

Graphics files must be raster graphics files in the format described here in order to print on the printer. To print vector graphics files, such as graphics files created for plotters, a vector-to-raster conversion must be performed on the data. (Vector-to-raster conversion is NOT a standard feature of the printer.) Text and graphics cannot mix on the same line due to grid conflicts. Raster graphics use 8-bit data.

Underlining

The ESC&dD sequence enables the automatic underlining mode. In this mode, each printed character and space is underlined until the printer receives an ESC&d@ sequence. The underline enhancement is disabled in the default state. Underlining only affects forward horizontal movement such as SP (space), DATA, or forward horizontal cursor moves; reverse movements such as BS (backspace), CR (carriage return) and negative horizontal cursor moves are not affected.

Character Overstrike

To create special symbols and underline selected portions of your output, one character (maximum) may be printed over another on a character-by-character or line-by-line basis.

A character overstrike is accomplished using either the backspace control code or a carriage return with no line feed. The overstrike print line will be held in the print buffer and will be merged with the next line to form a single printed line with superimposed characters.

Attempting to print more than two characters in any one print location will result in a loss of data integrity. (Only the last two characters received will be retained.)

When the automatic underlining enhancement is used (ESC&dD), the underlined character is not considered an overstrike character. Therefore, if the underlining enhancement was used to underline a character, another character could still be printed over it without risking data loss.

Bar Codes

To print bar codes, escape sequences are sent to the printer specifying the type of code, bar code height, bar code header information, placement information, and bar code data. The following five escape sequences are used for bar code printing:

ESC*z#V Bar Code Selection

This sequence selects the type of bar code to be used in subsequent printing of bar code data. If a number other than those available is selected, the previously selected bar code type will be used. The following table lists the bar code types available and their corresponding value field numbers.

Table 10. Bar Code Types

Bar Code Type	Character Length	Value Field No.
Code 3 of 9 (default)	Variable	0
Industrial 2 of 5	Variable	1
Interleaved 2 of 5	Variable	4
UPC A	Fixed	8
UPC E	Fixed	9
EAN 8	Fixed	10
EAN 13	Fixed	11
UCC/EAN-128	Fixed	12
Postnet	Fixed	13, 14
Royal Mail	Variable	15, 16

NOTE: The Postnet Barcode types 13 & 14 print 24 bars per inch. See the section on 256x Postal Barcodes for information on the 20 bars per inch and 22.5 bars per inch Postal Barcodes.

ESC*z#H Bar Code Height

This escape sequence defines the height of the bar code label in tenths of an inch as specified in the value field (#). To specify a bar code height of .8 inches, the ESC*z8H escape sequence would be sent to the printer. A zero in the value field specifies that bar code height is determined by the current line spacing (1/6 or 1/8 inch for 6/8 LPI respectively, or 1/3 or 1/4 inch for double-high/double-wide). The default bar code height is 0.6 inches.

ESC*z#C Bar Code Label Placement

This escape sequence specifies the horizontal starting location of a bar code by specifying the column number based on the currently active print pitch. The value field (#) indicates the absolute column position the bar code will begin printing. A plus or minus sign in the value field is ignored. A value field whose position is less than the current active printing position is illegal and causes the cursor to move to the next column position to the right of the current active printing position. When printing bar codes, always allow at least 1/4 inch margin in all directions from each bar code. This will limit the interference from other characters and help readability. If you need to print text and bar codes on the same line, see the “Printing Bar Codes With Text” discussion later in this chapter.

ESC*z#Q Bar Code Header Control

This sequence specifies the placement of the bar code header. A number 1 in the value field specifies that a header will be printed above the bar code label and a 2 specifies that it will be placed below the bar code. A zero in the value field specifies that no header will be printed. The printer default places the header above the bar code.

ESC*z<Bar Code Data>Z Bar Code Label Data

This sequence sends the bar code label data in the form of an alphanumeric string enclosed in angled brackets. The header (if enabled) will print in the location specified by the bar code header control sequence.

NOTE: Upon termination of the bar code label data escape sequence, the printer will print all buffered bar code data and generate a carriage return.

The printer automatically formats the bar code, inserts start and stop bits, and calculates and inserts checksum (if applicable-not for Code 3 of 9, Industrial 2 of 5, or Interleaved 2 of 5).

For UPC E bar codes, a zero (0) must be in the first position of the bar code data.

Printing Bar Codes

Generally, sending bar code information to the printer is performed in two steps:

Step 1: Selecting the bar code printing specifications; bar code type, height, and header control information.

Step 2: Moving the cursor to the desired label location and sending the bar code data.

Step 1.

Before positioning and printing the bar code data, the type of code, height of the label, and header placement may be specified. Once this is done, the succeeding labels will be printed using these specifications until a new type, height, or header control is specified. In other words, the bar code print specifications can be sent once and need not be sent again unless the printer is reset or new print specifications are desired. The following example specifies the print specifications for bar codes that are 0.5 inches in height, have a header above the label, and are printed in the UPC A code.

ESC*z8v5h1Q

ESC*z8v	Select UPC A code
5h	Label is to be .5 inches high
1Q	Places header above bar code

Notice that the last letter in the escape sequence (Q) is upper-case while the other letters in the sequence (v and h) are lower-case. (See “Escape Sequences” on page 15 for more information concerning combining two or more sequences.)

Step 2.

To print a bar code label, the cursor must be placed in the desired position and the bar code data must be sent. The following escape sequence moves the cursor to column 25, sends the data “1234567” to the printer, and initiates printing.

ESC*z25c<1234567>Z

ESC*z25c	Places start of label at column 25
<	Indicates start of bar code data
1234567	Bar code data
>	Signals end of bar code data
Z	Upper case Z initiates printing *

*Note that an upper-case “Z” terminator results in the bar code being printed and an automatic carriage return (CR) being executed.

Printing Multiple Labels On The Same Line

Printing more than one label on the same line involves no more than positioning the cursor and sending the data for each label to be printed. Since the termination of the bar code data sequence (signalled by an upper-case Z) causes the bar code to be printed and a carriage return to be executed, all of the label information must be sent in the same escape sequence. The following example shows an escape sequence used to print three labels on a single line:

ESC*z5c<label1>z20c<label2>z35c<label3>Z

ESC*z5c	Moves cursor to column 5
<label1>	Bar code data
z20c	Moves cursor to column 20
<label2>	Bar code data
z35c	Moves cursor to column 35
<label3>	Bar code data
Z	Initiates printing

Printing Bar Codes With Text

When printing bar codes with text, since the printer automatically generates a carriage return and line feed at the end of the terminating character (upper case Z), potential problems exist. As a general rule, for each line of bar code mixed with text, send the text information first, followed by a carriage return without a line feed (ASCII 13), and then overlay the bar code. (The carriage return is required so that the bar code cursor position will be correct.) The following example illustrates how to print text and bar codes on the same line.

This example involves a three-line bar code (and three escape sequences) as shown below:

ESC*z0v25c1q<12345>Z

ESC*z0v	Selects Code 3 of 9
25c	Moves cursor to column 25
1q	Specifies header placement above label
<12345>	Bar code data
Z	Enables printing this portion of the bar code

ESC*z75CThis is textCRESC*z0q25c<12345>Z

ESC*z75C	Moves cursor to column 75
This is text	Text for right of bar code
CR	Carriage return without a line feed
ESC*z0q	Disables header for this portion
25c	Moves cursor to column 25
<12345>	Bar code data
Z	Initiates printing this portion

ESC*z25c0q<12345>Z

ESC*z25c	Moves cursor to column 25
0q	Disables header for lower portion
<12345>	Bar code data
Z	Initiates printing for lower portion of label

NOTE: When a header is enabled, sending one line of information causes the printer to print two lines; one line containing the header along with any text you may have sent in that line, and one line containing the bar code label. When a header is enabled, no information can be printed on the same line as the bar code label. However, if the header is disabled, text can be placed next to the bar code label. For example, if you want a label and also wish to enclose the bar code with a box, you may not use automatic headers. Instead, you may set the height of the bar code to the text height and manually print the header.

Bar Code Width Information

The following paragraphs contain information concerning the size of the printed bar codes. If you are designing a form that contains bar codes, this information may prove useful in judging how much space the bar code will occupy.

The following table lists the number of characters sent by the user for each type of bar code:

Table 11. Bar Code Character

Bar Code	Number of Characters Sent
Code 3 of 9	Variable
Industrial 2 of 5	Variable
Interleaved 2 of 5	Variable
UPCA	11
UPCE	11
EAN8	7
EAN13	12
UCC/EAN-128	19
Postnet	5 (6), 9(10), or 11(12)
Royal Mail	Variable

NOTE: For Postnet Barcodes printed using the 5525B/31/32 style, if 5, 9, or 11 digits are sent, your printer will automatically calculate and print the check digit. If 6, 10, or 12 digits are sent, the printer will verify the check digit. Should the check digit be inaccurate, or an invalid bar code length is sent, your printer will not attempt to print the invalid data.

CODE 3 OF 9

A variable-length data string of up to 32 ASCII characters may be printed using the Code 3 of 9 bar code. The string may be an odd or even length and may use any of the standard characters (specified in MIL-STD-1189). If a non-valid character is used in the string, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. The width of the printed bar code can be approximated by the following equation:

Width in inches = (number of characters)/3.14 + 0.50

INDUSTRIAL 2 OF 5

A variable-length data string of up to 32 ASCII characters may be printed using the Industrial 2 of 5 bar code. The string may be an odd or even length and may use any character from 0 through 9. If a non-valid character is used in the string, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. Optional checksums are not inserted in the bar code. The width of the printed bar code can be approximated by the following equation:

Width in inches = (number of characters)/3.7 + 0.38

INTERLEAVED 2 OF 5

A variable-length data string of up to 32 ASCII characters may be printed using the Interleaved 2 of 5 bar code. The string may be an odd or even length. However, if the string is an odd length, a leading zero will be inserted to make a string of an even length. Valid data characters are 0 through 9. If a non-valid character is used in the string, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. Optional checksums are not inserted in the bar code. The width of the printed bar code can be approximated by the following equation:

Width in inches = (even number of characters)/6.25 + 0.15

UPCA

A fixed-length data string of 11 ASCII characters may be printed using the UPC A bar code. The string must have a length of 11 and may use any of the standard characters 0 through 9. If a non-valid character or string length is used, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. The width of the printed bar code does not vary and is 1.56 inches.

UPCE

A fixed-length data string of 11 ASCII characters may be printed using the UPC E bar code. The string length must be 11 and may use any of the standard characters 0 through 9 (however, the data pattern must meet the format of UPC E bar codes; UPC E is a shortened version of very specific patterns printable with UPC A). If a non-valid character or string length is used, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. For UPC E, a zero (0) is required in the first position of the bar code data (the number system character). The width of the printed bar code is not variable and is 0.81 inches.

EAN8

A fixed-length data string of 7 ASCII characters may be printed using the EAN 8 bar code. The string length must be 7 and may use any of the standard characters 0 through 9. If a non-valid character or string length is used, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. The width of the printed bar code is not variable and is 1.25 inches.

EAN13

A fixed-length data string of 12 ASCII characters may be printed using the EAN 13 bar code. The string length must be 12 and may use any of the standard characters 0 through 9. If a non-valid character or string length is used, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. The width of the printed bar code is not variable and is 1.56 inches.

Royal Mail

A variable length data string may be printed using the “Royal Mail 4 State Customer Code”. The string may use any character from 0 through 9 and alpha characters A through Z. A complete bar code consists of a set of distinct bars and spaces for each character followed by a checksum character and enclosed by a unique start bar, stop bar and quiet zone. A second version of the Royal Mail barcode prints with no stop bar, start bar or checksum character.

UCC/EAN 128

The UCC/EAN-128 bar code contains special characters which use unique codes to identify the leading and trailing end of the bar code. EAN/UCC 128 supports a full ASCII character set and provides standard alphanumeric keyboard characters and control and special characters.

The UCC/EAN-128 data structure requires an Application Identifier (AI) at the beginning of barcode data. Each AI determines the format and length of the data which follows. Refer to Table 12 for more detail.

Table 12. UCC/EAN-128 Application Identifiers

Application Identifier (AI)	Content	Format
00	Serial Shipping Container Code	n2+n18
02	Item Num. of Goods Within Another Unit	n2+n14
10	Batch or Lot Number	n2+an..20
11 (*)	Production Date (YYMMDD)	n2+n6
13 (*)	Packaging Date (YYMMDD)	n2+n6
15 (*)	Sell By Date (Quality) (YYMMDD)	n2+n6
17 (*)	Expiration Date (Safety) (YYMMDD)	n2+n6

Table 12. UCC/EAN-128 Application Identifiers (continued)

Application Identifier (AI)	Content	Format
20	Product Variant	n2+n2
21	Serial Number	n2+an..20
22	HIBCC = Quantity, Date, Batch and Link	n2+an..29
23 (**)	Lot Number (Transitional Use)	n3+n..19
240	Additional Product ID Assigned By Manufacturer	n3+an..30
250	Secondary Serial Number	n3+an..30
30	Quantity	n2+n..8
310 (***)	Net Weight, Kilograms	n4+n6
311 (***)	Length or 1st Dimension, Meters	n4+n6
312 (***)	Width, Diameter or 2nd Dimension, Meters	n4+n6
313 (***)	Depth, Thickness, Height or 3rd Dimension, Meters	n4+n6
314 (***)	Area, Square Meters	n4+n6
315 (***)	Volume, Liters	n4+n6
316 (***)	Volume, Cubic Meters	n4+n6
320 (***)	Net Weight, Pounds	n4+n6
321 (***)	Length or 1st Dimension, Inches	n4+n6
322 (***)	Length or 1st Dimension, Feet	n4+n6
323 (***)	Length or 1st Dimension, Yards	n4+n6
324 (***)	Width, Diameter, or 2nd Dimension, Inches	n4+n6
325 (***)	Width, Diameter, or 2nd Dimension, Feet	n4+n6
326 (***)	Width, Diameter, or 2nd Dimension, Yards	n4+n6
327 (***)	Depth, Thickness, Height, or 3rd Dimension, Inches	n4+n6
328 (***)	Depth, Thickness, Height, or 3rd Dimension, Feet	n4+n6
329 (***)	Depth, Thickness, Height, or 3rd Dimension, Yards	n4+n6
330 (***)	Gross Weight-Kilograms	n4+n6
331 (***)	Length or 1st Dimension, Logistics	n4+n6
332(***)	Width, Diameter, or 2nd Dimension, Meters, Logistics	n4+6
333 (***)	Depth, Thickness, Height or 3rd Dimension, Meters, Logistics	n4+n6
334 (***)	Area, Square Meters, Logistics	n4+n6
335 (***)	Gross Volume, Liters	n4+n6
336 (***)	Gross Volume, Cubic Meters	n4+n6
337 (***)	Kilograms Per Square Meter	n4+n6
340 (***)	Gross Weight, Pounds	n4+n6
341 (***)	Length or 1st Dimension, Inches, Logistics	n4+n6
342 (***)	Length or 1st Dimension, Feet, Logistics	n4+n6
343 (***)	Length or 1st Dimension, Yards, Logistics	n4+n6

Table 12. UCC/EAN-128 Application Identifiers (continued)

Application Identifier (AI)	Content	Format
344 (***)	Width, Diameter, or 2nd Dimension, Inches, Logistics	n4+n6
345 (***)	Width, Diameter, or 2nd Dimension, Feet, Logistics	n4+n6
346 (***)	Width, Diameter, or 2nd Dimension, Yards, Logistics	n4+n6
347 (***)	Depth, Thickness, Height or 3rd Dimension, Inches, Logistics	n4+n6
348 (***)	Depth, Thickness, Height or 3rd Dimension, Feet, Logistics	n4+n6
349 (***)	Depth, Thickness, Height or 3rd Dimension, Yards, Logistics	n4+n6
350 (***)	Area, Square Inches	n4+n6
351 (***)	Area, Square Feet	n4+n6
352 (***)	Area, Square Yards	n4+n6
353 (***)	Area, Square Inches, Logistics	n4+n6
354 (***)	Area, Square Feet, Logistics	n4+n6
355 (***)	Area, Square Yards, Logistics	n4+n6
356 (***)	Net Weight, Troy Ounce	n4+n6
357 (***)	Net Volume, Ounces	n4+n6
360 (***)	Volume, Quarts	n4+n6
361 (***)	Volume, Gallons	n4+n6
362 (***)	Gross Volume, Quarts	n4+n6
363 (***)	Gross Volume, Gallons	n4+n6
364 (***)	Volume, Cubic Inches	n4+n6
365 (***)	Volume, Cubic Feet	n4+n6
366 (***)	Volume, Cubic Yards	n4+n6
367 (***)	Gross Volume, Cubic Inches	n4+n6
368 (***)	Gross Volume, Cubic Inches	n4+n6
369 (***)	Gross Volume, Cubic Inches	n4+n6
37	Quantity of Units Contained (For Use With AI 02 Only)	n2+n..8
400	Customer’s Purchase Order Number	n3+an..30
401	Consignment Number	n3+an..30
410	Ship To (Deliver To) Location Code Using EAN-13	n3+n13
411	Bill To (Invoice To) Location Code Using EAN-13	n3+n13
412	Purchase From (Location Code of Party From Whom Goods Are Purchased)	n3+n13
413	Ship For UCC/EAN Location Code	n3+n13
414	EAN Location Code For Physical Identification	n3+n13
420	Ship To (Deliver To) Postal Code Within a Single Postal Authority	n3+an..20
421	Ship To (Deliver To) Postal Code With 3-Digit ISO Country Code Prefix	n3+n3+an..9
8001	Roll Products-Width, Length, Core Diameter, Direction and Splices	n4+n14

Table 12. UCC/EAN-128 Application Identifiers (continued)

Application Identifier (AI)	Content	Format
8003	UPC/EAN Number and Serial Number or Returnable Asset	n4+n14+an..16
8004	UCC/EAN Serial Identification	n4+an..30
8005	Identifies the Price Per Unit of Measure	n4+n6
8006	Component of an Article	n4+n14+n2+n2
8018	Service Relation Number	n4+n18
8100	Coupon Extended Code-Number System Character and Offer	n4+n1+n5
8101	Coupon Extended Code-Number System Character, Offer and End of Offer	n4+n1+n5+n4
8102	Coupon Extended Code-Number System Character Preceded by Zero	n4+n1+n1
90	Mutually Agreed, Between Trading Partners	n2+an..30
91	Intra-Company (Internal)	n2+an..30
92	Intra-Company (Internal)	n2+an..30
93	Intra-Company (Internal)	n2+an..30
94	Intra-Company (Internal)	n2+an..30
95	Internal-Carriers	n2+an..30
96	Internal-Carriers	n2+an..30
97	Intra-Company (Internal)	n2+an..30
98	Intra-Company (Internal)	n2+an..30
99	Internal	n2+an..30

(*)To indicate only year and month, DD must be filled with “00”
(**) Plus one digit for length indication
(***) Plus one digit for decimal point indication

Data Value Representation:

a - alphabetic characters
an - alpha-numeric characters
an..3 - up to 3 alpha-numeric characters
n - numeric characters
n3 - 3 numeric characters, fixed length
n..3 - up to 3 numeric characters

US Postnet Barcodes

The printer can print barcodes in three different formats. The default, 24 bars per inch, uses the same syntax as the other barcodes. It is suggested to use the ESC*Z0Q command to disable placement of a header on postal barcodes. The printer will also print barcodes using the 256X format for 20 and 22.5 bars per inch postal barcodes. See the section on 256X - US Barcodes for more details. 5525B/31/32 style Postnet barcodes will automatically generate the check digit if it is not present. The 256X-compatibility barcodes require the host to generate the check digit. If a non-valid character or string length is used, a blank non-readable bar code will be printed; non-valid characters are not substituted or deleted. The width of the printed bar code is not variable and is 1.33 (5 digit), 2.17 (9 digit), or 2.59 (11 digit) inches.

256X US POSTNET BAR CODE

The US POSTNET Bar Code is a Compaq character set which meets the US Postal Office specifications for Postnet bar coding, including the latest Delivery Point Bar Code, or DPBC.

US POSTNET Bar Codes print at 4.0 cpi (20 bars per inch) and 11.3 cpi (22.5 bars per inch).Both bar codes are printed by replacing normal printable characters with vertical bars. Both options use different characters to represent the desired bar codes, as a result the methods by which they are produced are incompatible.

11.3 CPI (22.5 Bars per inch) US POSTNET BAR CODE

FONT SELECTION

You may select either of the US POSTNET character sets from either the front panel or through escape sequences. (Refer to the *User's Manual* for details on front panel menus.)

The following escape sequence will configure the 11.3 cpi POSTNET BAR CODE as a secondary font:

ESC)1KESC)s11.3H

The sequence above sets the secondary font symbol set to 11.3 cpi POSTNET BAR CODE, and sets the pitch to 11.3 cpi. Once the Secondary character set is configured for 11.3 cpi Postnet Bar Codes, the Shift Out command can be used to activate the bar codes:

Shift Out: hex 0E

After the bar code is printed, the normal print mode is activated by using the Shift In command:

Shift In: hex 0F

NOTE: It is recommended setting the US POSTNET Bar Code character set as the secondary set, with the normal operation mode as the primary font.

Printing 11.3 CPI US POSTNET Bar Code Information

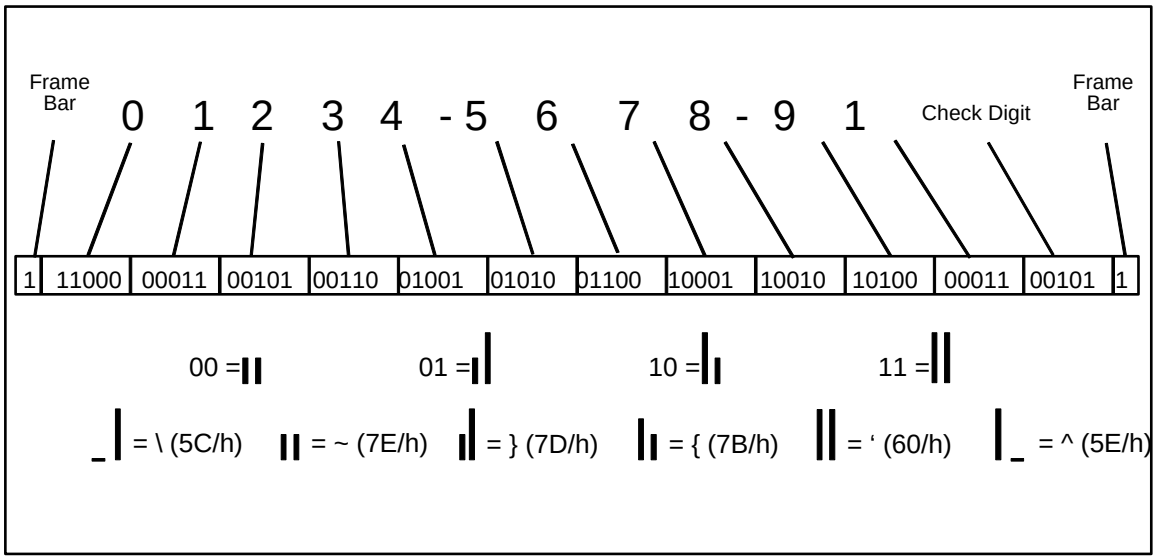
The US POSTNET BAR CODES represent digits 0 - 9 with five vertical bars. Each digit consists of two long bars (1's) and three short bars (0's). The Delivery Point Bar Code font is designed to be printed only at 11.3 cpi or 22.5 bars per inch. A Delivery Point Bar Code is an eleven digit postal code. (For five or nine postal bar codes, use the 4.0 cpi US POSTNET Bar Code.)

The eleven numeric characters are : ZIP + 4 + 2

To make the bar code scannable, you must add a check digit and frame bars. The check digit is calculated by adding all of the digits and subtracting the sum from the next highest multiple of ten. Consequently, the sum of the eleven digits, and the check digit, will be an even multiple of ten.

The printer does not calculate the check digit, or automatically generate frame bars. They must be generated by the computer resident software, and sent to the printer. To do this, it is necessary to design a program that will convert a pair of digits into ten vertical bars.

NOTE: Each digit is five bars, with each printable character being two bars. Thus, 2 1/2 characters are needed to print one digit.



Perform the following steps to determine the check digit for 45834-8844-70:

1. Calculate the check digit:

   Add the digits of the postal code: 4+5+8+3+4+8+8+4+4+7+0 = 51

2. Subtract from the next highest multiple of ten:

   60-51 = 9

The check digit is 9.

The barcode can be created one of two ways. The first, uses the frame bars as separate characters, the second “links” the frame bars to the first and last characters.

	Method 1:	
Frame Bar:	\	(1)
Characters “45”:	}~{{{	(01001 01010)
Characters “83”:	{}~}{	(10010 00110)
Characters “48”:	}~`~{	(01001 10010)
Characters “84”:	{}~{}	(10010 01001)
Characters “47”:	}~}~}	(01001 10001)
Characters “09”:	`~}}~	(11000 10100)
Frame Bar:	^	(1)
Text sent to Printer:	SO\}~{{{{}~}{}~`~{{}~{}}~}~}`~}}~^SI	

	Method 2:	
Frame Bar & “4”:	{{}	(1 01001)
Characters “58”:	}}}~{	(01010 10010)
Characters “34”:	~`~{}	(00110 01001)
Characters “88”:	{}}~{	(10010 10010)
Characters “44”:	}~{{}	(01001 01001)
Characters “79”:	{~`{~	(10001 11000)
“9” & Frame Bar:	{{}	(10100 1)
Text sent to Printer:	SO{{}}}}~{~`~{}{}}~{}~{{}{~`{~{{}SI	

For both examples, SO = Shift Out (hex 0E), and SI = Shift In (hex 0F).

4.0 CPI (20 Bars per inch) US POSTNET Bar Code

FONT SELECTION

You may select either of the US POSTNET character sets from the front panel, or through escape sequences. (Refer to your *User’s Manual* for details on front panel menus.)

The following escape sequence will configure the 4.0 cpi POSTNET BAR CODE as a secondary font:

ESC)0K

ESC)0KESC)s4.0H

The sequence above sets the secondary font symbol set to 4.0 cpi POSTNET BAR CODE, and sets the pitch to 4.0 cpi. Once the Secondary character set is configured for 4.0 CPI Postnet Bar Codes, the Shift Out command can be used to activate the bar codes:

Shift Out: hex 0E

After the bar code is printed, the normal print mode is activated by using the Shift In command:

Shift In: hex 0F

NOTE: It is recommended setting the US POSTNET Bar Code character set as the secondary set, with the normal operation mode as the primary font.

Perform the following steps to determine the check digit for 45834-8844-70:

1. Calculate the check digit:

   Add the digits of the postal code: 4+5+8+3+4+8+8+4+4+7+0 = 51

2. Subtract from the next highest multiple of ten:

   60 - 51 = 9

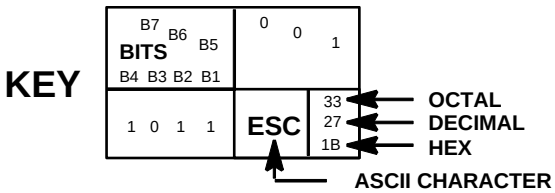
The check digit is 9.

Text sent to Printer:

SONUL458348844709SI

SO = Shift Out (hex 0E)
NUL = Nul (hex 00)
SI = Shift In (hex 0F)

A *Standard ASCII Character Set*



B7 B6 B5 / BITS B4 B3 B2 B1	ROW	0 0 0 / COLUMN 0		0 0 1 / 1		0 1 0 / 2		0 1 1 / 3		1 0 0 / 4		1 0 1 / 5		1 1 0 / 6		1 1 1 / 7	
0 0 0 0	0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
0 0 0 1	1	SOH	1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
0 0 1 0	2	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
0 0 1 1	3	ETX	3 3 3	DC3 (XOFF)	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
0 1 0 0	4	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
0 1 0 1	5	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
0 1 1 0	6	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
0 1 1 1	7	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
1 0 0 0	8	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
1 0 0 1	9	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
1 0 1 0	10	LF	12 10 0 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
1 0 1 1	11	VT	13 11 0 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
1 1 0 0	12	FF	14 12 0 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
1 1 0 1	13	CR	15 13 0 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
1 1 1 0	14	SO	16 14 0 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
1 1 1 1	15	SI	17 15 0 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

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5525B/31/32 Line Matrix Printer

Compaq Computer Corporation

P/N 422932-001

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